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INVESTOR IN PEOPLE

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I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

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Signed

Dated 7 January 2005

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25NOV03 E854617-3 D00790
P01/7700 0.00-0327301.8

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference — PA 4995

2. Patent application number *(The Patent Office will fill this part in)* — 0327301.8

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

PetroTecknik Limited
PetroTechnik House
Olympus Close
Whitehouse Industrial Estate
Ipswich
Suffolk IP1 5LN

Patents ADP number *(if you know it)* 08759318001

If the applicant is a corporate body, give the country/state of its incorporation — United Kingdom

4. Title of the invention — CONNECTION BETWEEN A PIPE AND A WALL

5. Name of your agent *(if you have one)* — **SOMMERVILLE & RUSHTON**

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

45 Grosvenor Road
St Albans
Hertfordshire
AL1 3AW

Patents ADP number *(if you know it)* — 1511001

6. Priority: Complete this section if you are declaring priority from one or more earlier patent applications, filed in the last 12 months.

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. Divisionals, etc: Complete this section only if this application is a divisional application or resulted from an entitlement dispute (see note f)

Number of earlier UK application	Date of filing *(day / month / year)*

8. Is a Patents Form 7/77 (Statement of inventorship and of right to grant of a patent) required in support of this request? — YES

Answer YES if:
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
Otherwise answer NO (See note d)

Patents Form 1/77

9. Accompanying documents: A patent application must include a description of the invention. Not counting duplicates, please enter the number of pages of each item accompanying this form:

Continuation sheets of this form	
Description	10
Claim(s)	0
Abstract	0
Drawing(s)	7+7

DL

10. If you are also filing any of the following, state how many against each item.

Priority documents	0
Translations of priority documents	0
Statement of inventorship and right to grant of a patent (Patents Form 7/77)	0
Request for a preliminary examination and search (Patents Form 9/77)	0
Request for a substantive examination (Patents Form 10/77)	0
Any other documents (please specify)	0

11. I/We request the grant of a patent on the basis of this application.

Signature(s) Sommerville & Rushton Date 24 November 2003

12. Name, daytime telephone number and e-mail address, if any, of person to contact in the United Kingdom

Dr Ian H Coates
01727 854215

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.

b) Write your answers in capital letters using black ink or you may type them.

c) If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.

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f) Part 7 should only be completed when a divisional application is being made under section 15(4), or when an application is being made under section 8(3), 12(6) or 37(4) following an entitlement dispute. By completing part 7 you are requesting that this application takes the same filing date as an earlier UK application. If you want the new application to have the same priority date(s) as the earlier UK application, you should also complete part 6 with the priority details.

CONNECTION BETWEEN A PIPE AND A WALL

Field of the Invention

This invention relates to fittings for providing a seal between a wall and a pipe passing through an opening in the wall, to a method of providing such a seal, and to an assembly comprising the combination of a pipe, a wall and a fitting providing a seal between the two. The invention is particularly applicable to the provision of a seal between a pipe and a wall of a manhole chamber as found in a subterranean fuel tank or between a pipe and the wall of sump for a dispensing pump, for example in a petroleum forecourt installation, and in particular where the wall of a chamber or sump is made of glass reinforced plastic (GRP).

Background to the Invention

Subterranean piping systems of the type that are typically installed at service stations are generally utilized to communicate fuel or chemicals between an underground storage tank and an above ground dispensing station. The underground storage tanks and associated piping pose serious potential environmental and fire hazards as the chemicals contained therein could and have in the past leaked into the earth.

Oil companies have been under considerable pressure to ensure that environmental concerns are given priority in the planning and installation of petrol station infrastructures. This has not been without significant on-cost. One important advancement has been the use of pipeline systems constructed from plastics materials which have enabled the oil companies to install cost-effective environmentally acceptable alternatives to steel pipework systems which tend to corrode over time.

Moreover, over recent years there have been major developments in fuel technology which have culminated in commercially available alternative fuels containing additives which have replaced lead-based antiknock compounds. Research also continues to centre on reducing sulphur content and hazardous emissions from fuel. In order to eliminate lead and sulphur from fuels, exotic additives and octane enhancers such as MTBE (methyl tertiary butyl ether) have been developed which are based on complex organic or heavy metal organic additives.

The presence of these additives in fuel can give rise to major environmental issues. Some such issues are described in an article entitled "MBTE – How should

Europe Respond", in Petroleum Review February 2000 pages 37-38. The entire text of this article is incorporated herein by reference by way of background information. The authors conclude that lead and some other metals are the most effective octane enhancers. However, lead is in the final stages of being phased out because of environmental and health issues, and the most readily available alternative, MMT (methylcyclopentadienyl manganese tricarbonile) is currently not widely accepted. The only other octane enhancers currently available are MTBE and other ethers such as ethyl tertiary butyl ether (ETBE) and tertiary amyl methyl ether (TAME), or alcohols such as ethanol. The ethers all tend to have similar properties and drawbacks. Ethanol is already used as a gasoline-blending component in parts of the United States where it is readily available, and in Brazil. It is an effective octane booster but has a number of drawbacks: it needs a "water-free" distribution system and is not without ground water issues. It is currently not recommended by the motor industry and is not cost-competitive.

The introduction of new fuel mixtures and esoteric additives has led oil companies to question whether existing pipeline systems can cope with the new fuels with regards to mechanical performance and permeability resistance. In some instances this will result in the pipework having to be replaced by pipework made from a more resistant material, with all the disruption that entails.

In petroleum forecourt installations, pipework running between dispensing pumps and a subterranean fuel storage tank passes into a manhole chamber which is situated directly above the manhole lid of the tank. The chamber is normally defined by an upstanding wall which, when viewed from above, can be of an octagonal, square, circular or rectangular shape, and which includes apertures through which respective pipes pass.

To overcome environmental concerns this pipework is now generally constructed from plastics materials and many current designs of forecourt installation utilise secondary containment. This involves containing each fuel supply pipeline in a respective secondary containment pipeline which is optionally sealed at its ends to the fuel supply pipeline. The secondary containment pipeline prevents leaks from the fuel supply pipeline from being discharged into the environment, and also can convey leaked petrol to a remote-sensing device. Typically, the pipes forming the secondary containment pipeline are initially separate from the fuel pipes and are sleeved over the latter as the fuel pipes are installed between the fuel storage tanks and dispensing pumps.

A common material for the chamber to be constructed from is glass-reinforced plastic which involves moulding a resin or other polymeric material reinforced with fibres such as glass fibres.

It is desirable to provide a seal between each of the apertures and its respective pipe to avoid ingress of water into the manhole chamber. To that end, it is known to attach a fitting to a portion of the wall around the aperture and a rubber "boot" that sleeves over the pipe and is clamped to both the pipe and the fitting by, for example, jubilee (TM) clips. Some types of such fitting are bolted to the chamber wall, whilst other types of fitting provide inner and outer parts between which the wall is sandwiched, the inner and outer parts being held together by a screw-threaded connector which extends through the aperture. These connectors often incorporate a rubber seal located between a part of the connector and the chamber wall.

Neither type of fitting provides a completely effective seal.

Over time, both types of seal can allow water to leak into the manhole chamber and to accumulate in a pool in the bottom of the chamber. This in turn makes the maintenance of the chamber bottom and tank entrance extremely difficult. In addition a defective seal can allow any petroleum fluid or vapours which find their way into the chamber to escape into the environment.

It would be preferable if such a fitting could be chemically bonded or electrofusion welded both to the pipe and to the chamber wall. One type of such fittings, manufactured from a plastics material capable of electrofusion to both the pipe and the chamber wall is known from GB2332255 (PetroTechnik Ltd). However, these fittings cannot be used when the chamber is constructed from GRP, a material commonly used in construction of chambers and sumps for this application.

In summary therefore, in the event that pipework has to be replaced, or in new build situations, there is a requirement to seal pipework made from polyethylene, polypropylene, polyamide or the like to a GRP chamber wall. Accordingly it is an object of the present invention to provide a fitting for forming a seal between pipework formed from a plastics materials and a GRP chamber which overcomes some or all of the above disadvantages.

Summary of the Invention

According to a first aspect of the invention there is provided a fitting for providing a substantially fluid tight seal between an opening in a chamber wall and a pipe passing through said opening, said fitting comprising:-

(i) a first tubular sleeve adapted to pass through the opening in the chamber wall and;

(ii) a second tubular sleeve adapted to form a fluid tight fit with the first tubular sleeve, both the first tubular sleeve and the second tubular sleeve being adapted to allow the pipe to pass therethrough;

characterised in that the material of the first tubular sleeve is formed from a fibre reinforced plastics material and that the material of the second tubular sleeve is formed from an electrofusible polymeric plastics material.

By forming a first part of the fitting from a fibre-reinforced plastic and a second part of the fitting from a plastics material electrofusible to the pipework, a strong, long-lasting fluid-tight seal can be formed between the fitting and both the chamber wall and the pipe.

Preferably the first and second tubular sleeves overlap for a proportion of their length, the fluid-tight seal between the two sleeves being formed in that overlapping region.

Preferably the first tubular sleeve further comprises a flange, extending radially outwardly from the sleeve, a first surface of the flange being configured to contact the chamber wall around substantially the whole circumference of the opening.

Preferably the fitting further comprises a sealing means located between the first tubular sleeve and the second tubular sleeve, said sealing means being adapted to form a fluid-tight seal between the two overlapping sleeves.

In a particularly preferred embodiment the sealing means takes the form of an O-ring seal seated in a circumferential channel around one or other of the sleeves.

In a further preferred embodiment the fitting further comprises a third tubular sleeve, formed from a metal, and adapted to fit tightly inside the fitting in the region in which the first and second tubular sleeves overlap.

Preferably the third tubular sleeve is formed from stainless steel, coated steel or a polymer resistant to fuel.

It will be appreciated that the present invention also extends to encompass underground pipework systems including such fittings, and to garage forecourt systems incorporating them.

Brief Description of the Drawings

The present invention will now be described by way of examples only with reference to the accompany drawings wherein:-

Figure 1 is a partially cut-away side view of part of a petroleum forecourt installation which includes a tank having a manhole chamber, having a fitting in accordance with the invention;

Figure 2 illustrates a cross-section through a fitting according to one embodiment of the present invention;

Figure 3 illustrates an elevational view of the fitting shown in Figure 2;

Figure 4 illustrates a cross-section through a first tubular sleeve of the fitting shown in Figure 2;

Figure 5 illustrates a cross-section through a third tubular sleeve of the fitting shown in Figure 2;

Figure 6 shows an end elevation of the fitting of Figure 2;

Figures 7, 8 and 9 show fittings according to the present invention in use through a chamber wall.

Description of the Preferred Embodiments

The present embodiments represent currently the best ways known to the applicant of putting the invention into practice. But they are not the only ways in which this can be achieved. They are illustrated, and they will now be described, by way of example only. By way of terminology used in this document the following definitions apply:-

chamber – any receptacle designed to keep a fluid in or out. This includes, but is not limited to, manhole and sump chambers as described herein. It also includes tanks in general.

energy transfer means – a generic term describing any form of energy source. Typically it takes the form of a resistance winding which heats up when an electrical current is passed through it. The term also encompasses other welding techniques including ultrasonic welding and induction welding.

flange – any collar suitable for attaching a fitting to a chamber wall. In the examples given the surface of the flange which contacts the chamber wall is substantially planar. However, it will be understood that the flange must conform to the profile of the chamber wall around the pipe inlet opening. Thus the flange can adopt any suitable conformation to achieve the necessary contact with a flat or curved surface or even the corner of a container wall.

fluid – whilst the examples provided relate mainly to liquids, the term fluid refers to liquids, vapours and gases. For example, should a leak occur in a secondarily contained pipe in a garage forecourt installation then petrol or petrol vapour will collect in the manhole chamber. It is essential that this petrol vapour cannot escape through the wall of the chamber and into the surrounding ground.

pipe – the examples given herein are for a generally circular cross-sectioned single wall pipe. However, the invention also covers other cross-sections such as box sections, corrugated and the like and secondarily contained pipes of the "pipe-within-a-pipe" type. In this case the sealing member or boot for sealing the sleeve to the pipe will be rather more complex. However, such boots are well known in the art. The invention also encompasses pipes which are not circular in cross-section.

tubular sleeve - this term has a very broad meaning. It includes any tubular structure through which a pipe may pass. Although illustrated and described as substantially circular cylindrical in form, a sleeve according to this invention need not have a substantially circular cross-section and may confirm to the profile of the pipe to be accommodated in it. Nor need the cross-section of the sleeve be uniform along its whole length, ie it need not be cylindrical.

Glass reinforced plastic (GRP) – The term GRP has a very broad meaning in this context. It is intended to encompass any fibre-reinforced plastic wherein a fibre of any type is used to strengthen a thermosetting resin or other plastics material.

The petroleum forecourt installation shown in Figure 1 comprises a pair of dispensing pumps 1 and 2 connected to a subterranean tank 3 through a pipeline 4. The pipeline 4 is formed from contiguously arranged sections of polyethylene pipe. The pipeline 4 extends from the pumps 1 and 2 into a manhole chamber 6 immediately above the tank 3. The chamber 6 is defined by a GRP member 8 having a side wall 10 and a base 12.

Figure 1 shows two lines extending from the pipeline 4 into the tank 3. These lines relate to two alternative forms of fuel supply system and are both shown for the sake of completeness. In practice, only one of the lines would extend from the pipeline 4 into the manhole chamber 6. One of those lines is a suction line 14 which is used where the dispensing pumps and 2 are fitted with suction pumps. The alternative line, reference 16, is a pressure line connected to the pipeline 4 via a pump 18 which is operable to propel fuel from the tank 3 to the pumps 1 and 2.

It can be seen from Figure 1 that the wall 10 has to be apertured in order to allow the pipeline 4 to pass into the chamber 6. In order to prevent water leaking from the surrounding ground (here denoted by reference numeral 20) into the

chamber 6 through the aperture, the pipe is sealed to the cylindrical wall 10 by means of a fitting 22 shown in more detail in Figures 2 to 9 inclusive. In the event of a spillage or a leak in a supply pipe the seal also prevents fuel from escaping into the environment.

Figure 2 illustrates the fitting 22 in greater detail. The purpose of this fitting is to form a strong, permanent, fluid-tight seal between the fitting and the chamber wall 10 and between the fitting and the pipework system 4. Fitting 22 comprises a first tubular sleeve 31 formed from GRP. The sleeve 31 is generally cylindrical in shape with a longitudinal axis through which a pipe (not shown) can pass. A second tubular sleeve 32 is moulded around one end of the first tubular sleeve, the sleeve 32 being formed from an electrofusible polymeric plastics material, compatible with the pipework system, such as polyethylene, polyamide or PVDF. Suitable materials will be discussed in more detail below.

In order to improve the fluid-tight nature of the seal between the two sleeves, a series of grooves, slots or ridges 34 are formed in the region of the first sleeve where the two sleeves overlap. When the second sleeve is formed around the first, plastics material fills these grooves, preventing the two components from separating in use.

Advantageously, part of the first tubular sleeve is encapsulated within part of the second tubular sleeve such that there is an overlapping region between the two sleeves. Encapsulating part of the first sleeve within the second sleeve creates a stronger fitting and one less prone to leakage over time.

It should be remembered that these fittings can often be used in inhospitable conditions, eg underground where there may be soil shrinkage, subsidence or other movement, and where fuel can escape in the case of a supply pipe failure.

Optionally, the seal between the two sleeves can be further improved by incorporating a sealing means such as an O-ring 36. The O-ring in this example nests into a annular channel around the circumference of one or other of the sleeves. It will be appreciated that the O-ring seal can be positioned during assembly on either the first or second sleeve. For ease of construction it would normally be positioned on the outer surface of the first tubular sleeve, towards the end of that sleeve which is located within the main body of the fitting itself.

It will be appreciated that the O-ring could also be positioned in the end face 37 of the first sleeve, engaging with a shoulder 38 in the second sleeve.

Because the O-ring is internal to the fitting, and sealed within, it is expected to have a very long life, at least the life of the fitting.

There is a further optional feature which serves to strengthen the fluid-tightness for the seal between the first and second sleeves. A third tubular sleeve 33 is located on the inner surface of the fitting in the region where the first and second sleeve overlap. The purpose of this third sleeve, which is made from a metal such as stainless steel, coated steel or a polymer, is to prevent the polymeric plastics material component from withdrawing away from the first, GRP sleeve in the event it should shrink or soften when exposed to fuel or other chemicals.

Figure 3 illustrates a side elevational view of fitting 22 showing the neat, streamlined appearance and form resulting from this method of construction. A reference mark 39 enables an electrofusion coupling (see below) to be positioned and properly located over the end of the fitting made from elctrofusible plastic. It also serves to identify that end of the fitting, if there were any doubt.

Figure 4 shows a cross-sectional view of the first tubular sleeve 31 and shows in more detail the slots 34. It will be apparent from Figure 4 the general simplicity of this GRP moulding. The slots 34 can take a wide variety of shapes, sizes, location and configuration. The essential feature is that they create indentations into which the liquid plastics material of the second tubular sleeve component can flow during manufacture.

In an alternative form of construction the slots 34 could take the form of screw threads such that the first and second sleeves could be formed separately and screwed together during construction. A chemical adhesive or a locking screw (not shown) could then be used to prevent the two sleeves coming apart during use.

Figure 5 shows the third tubular sleeve component in cross-section. This can be pressed into place after the second sleeve has been formed around the first, but while the material of the second sleeve is still warm and thus deformable.

In use, and referring to Figures 8 and 9, the end of the GRP portion of the fitting is passed through an aperture in the chamber wall and temporarily held in place. A GRP bandage (not shown) is then used to seal the fitting to the chamber wall on one or both sides. The advantage of this arrangement is that both the fitting and the chamber wall are made of the same or compatible materials such that a strong, permanent, fluid-tight seal can be easily formed. The necessary rubber boot 55, 56, is then used in conventional fashion to form a seal inside the chamber where a secondary pipework system is used. Outside the chamber electrofusion fittings may be used, together with expanders or reducers as necessary, to accommodate secondarily contained pipe.

In Figure 8 both the primary pipe 61 and the secondary pipe are sized such that they will pass through the fitting 22. The secondary pipe 60 is therefore sealed to the outside fitting 22 by way of an electrofusion coupling 62, expander 63 and electrofusion coupler 64. The termination between the primary and secondary pipes takes place inside the chamber using rubber boot 56.

It will be appreciated from Figure 9, where the secondary pipe 50 containing the supply pipe 51 is larger than the internal diameter of the fitting, then the fitting itself becomes part of the secondary containment system. This is achieved through use of electrofusion coupling 52, reducer 53 and coupling 54 which in effect connects the secondary pipe 50 to the outside of the fitting 2. This illustrates part of the versatility of a fitting according to a first aspect of the present invention.

An alternative and preferred fitting incorporating a flange is shown in Figure 7. Flange 40 extends radially from the GRP component of the fitting and may be formed integrally during construction of the first tubular sleeve. The flange is configured to conform to the shape of the chamber wall in the region of the aperture to be sealed. In this example it is shown as planar but other configurations are possible.

In use, resin is applied to the flange and the fitting clamped in place against the chamber wall while the resin sets. Further assembly takes place as described above.

Preferably the second tubular sleeve component is formed from one or more plastics materials selected from the group comprising:-

polyethylene;
polypropylene;
polyvinyl chloride;
polybutylene
polyurethanes;
polyamides, including polyamides 6, 6.6, 6.10, 6.12, 11 and 12;
polyethylene terphthalate;
polybutylene terephthalate;
polyphenylene sulphide;
polyoxymethylene (acetal);
ethylene/vinyl alcohol copolymers;
polyvinylidene fluoride (PVDF) and copolymers;
polyvinyl fluoride (PVF);

tetrafluoroethylene-ethylene copolymer (ETFE);
tetrafluoroethylene-hexafluroethylene copolymers (FEP)
ethylene tetrafluoroethylene hexafluropropylene terpolymers (EFEP)
terpolymers of tetrafluoroethylene, hexafluoropropylene and vinylidene fluoride (THV);
polyhexafluoropropylene;
polytetrafluoroethylene (PTFE);
polychlorotrifluoroethylene;
polychlorotrifluoroethylene (PCTFE);
fluorinated polyethylene;
fluorinated polypropylene;
and blends and co-polymers thereof.

This selection is not intended to be limiting but rather demonstrates the flexibility and breadth of the invention. The plastics material which is most compatible to the pipe to which it will be joined and with the lowest permeability to the fluid in question will usually be chosen by the materials specialist. Furthermore, it is known to use blends of two or more polymers and this invention extends to cover known and yet to be developed blends of plastics material.

The GRP resin component can be formed from any suitable thermosetting resin as selected by the materials specialist, including but not limited to polyester or epoxy resins.

The GRP sleeve can be formed by any of the conventional techniques used to mould GRP including hand lay-up, compression moulding or injection moulding. The present invention also extends to moulding methods yet to be discovered.

The examples described above relate principally to single wall chambers. However, fittings according to the present invention can be used equally well with double-walled chambers where there is an interstitial space between the two chamber walls. In that case a seal is formed between the fitting and the outer wall and between the fitting and the inner wall. This can be done using two bandages, one outside and one inside the chamber, or by a flange and a bandage. In either case the integrity of the interstitial space between the chamber walls is maintained and can be monitored.

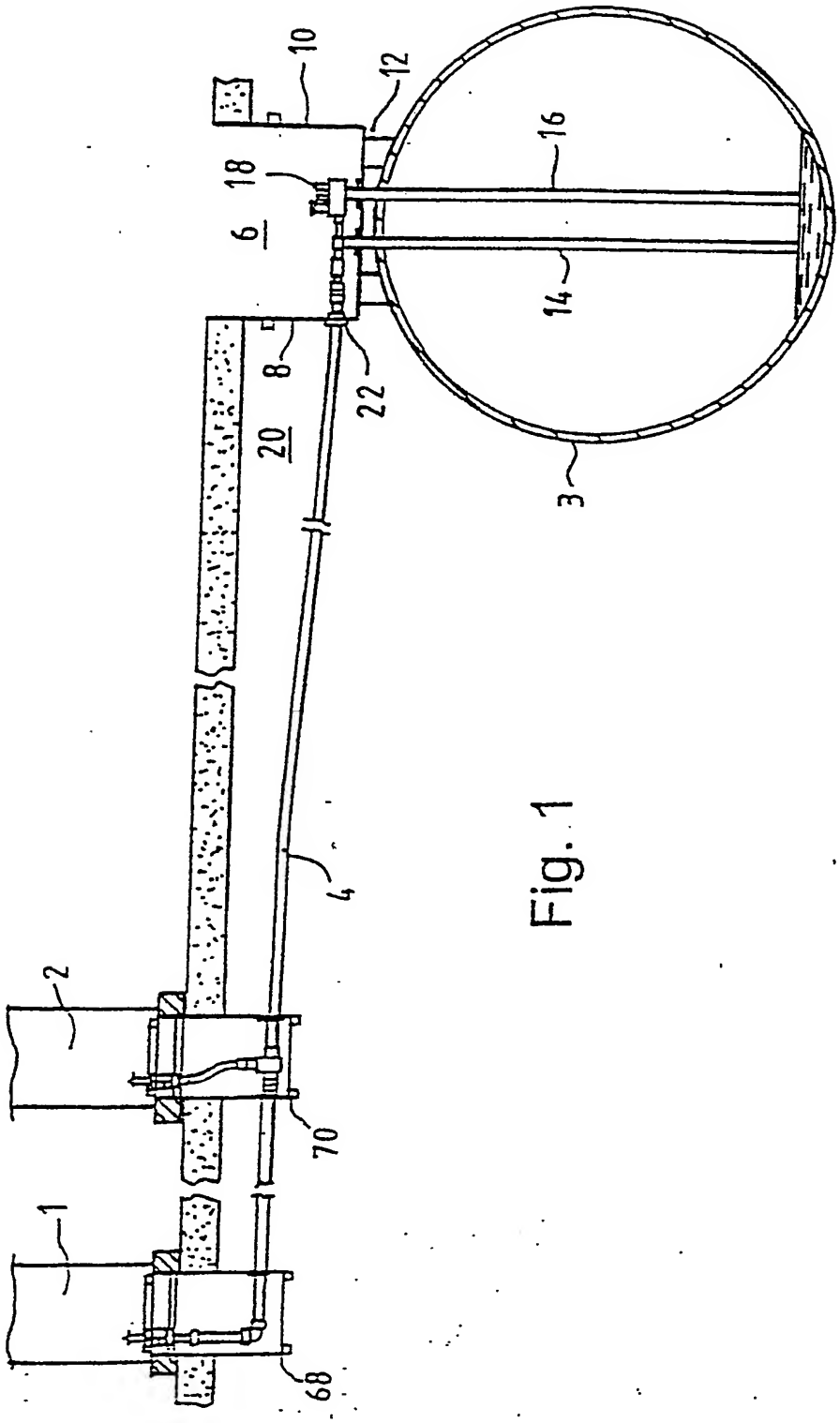

Fig. 1

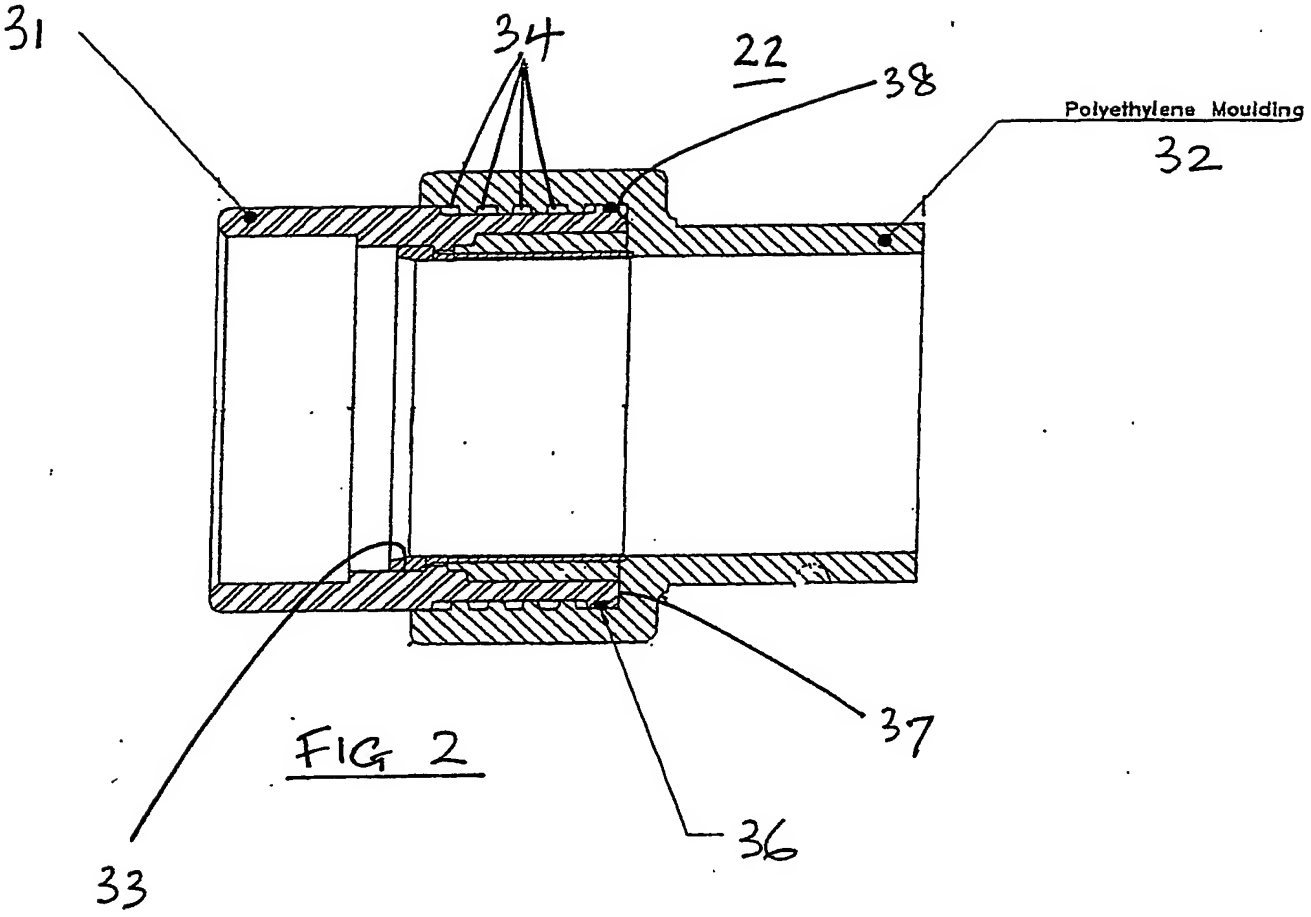

FIG 2

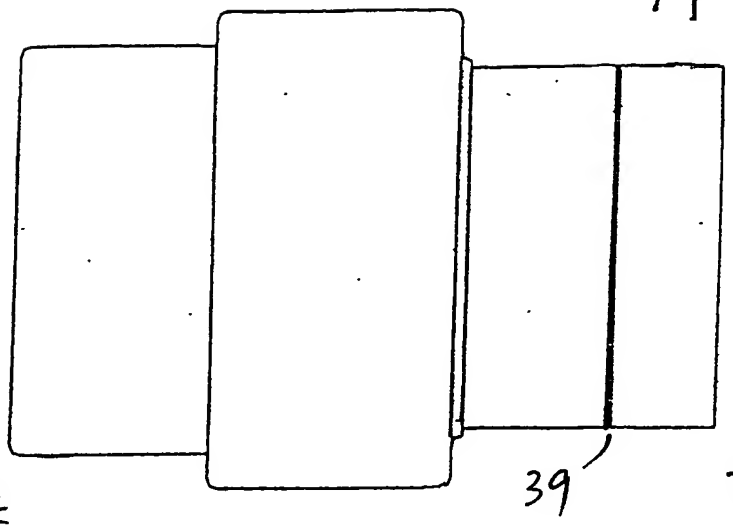

FIG 3

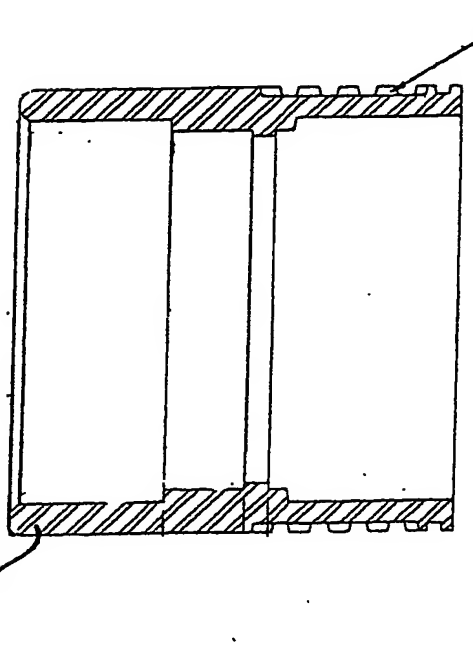

FIG 4

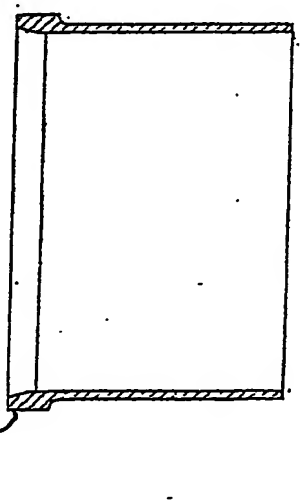

FIG 5

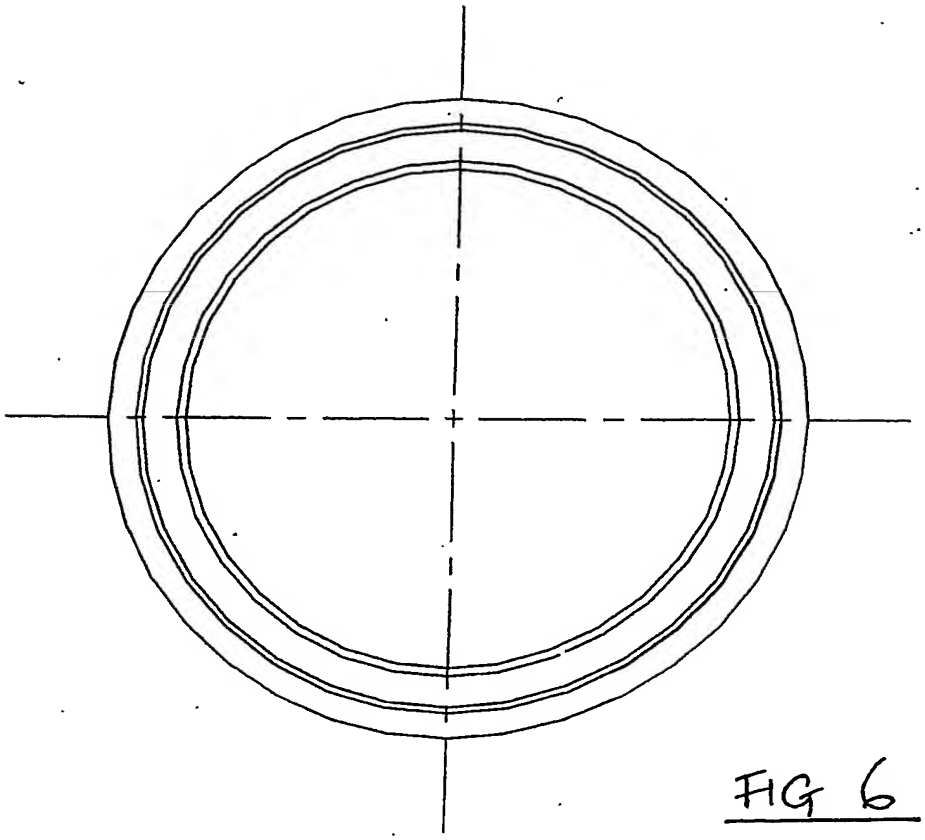

FIG 6

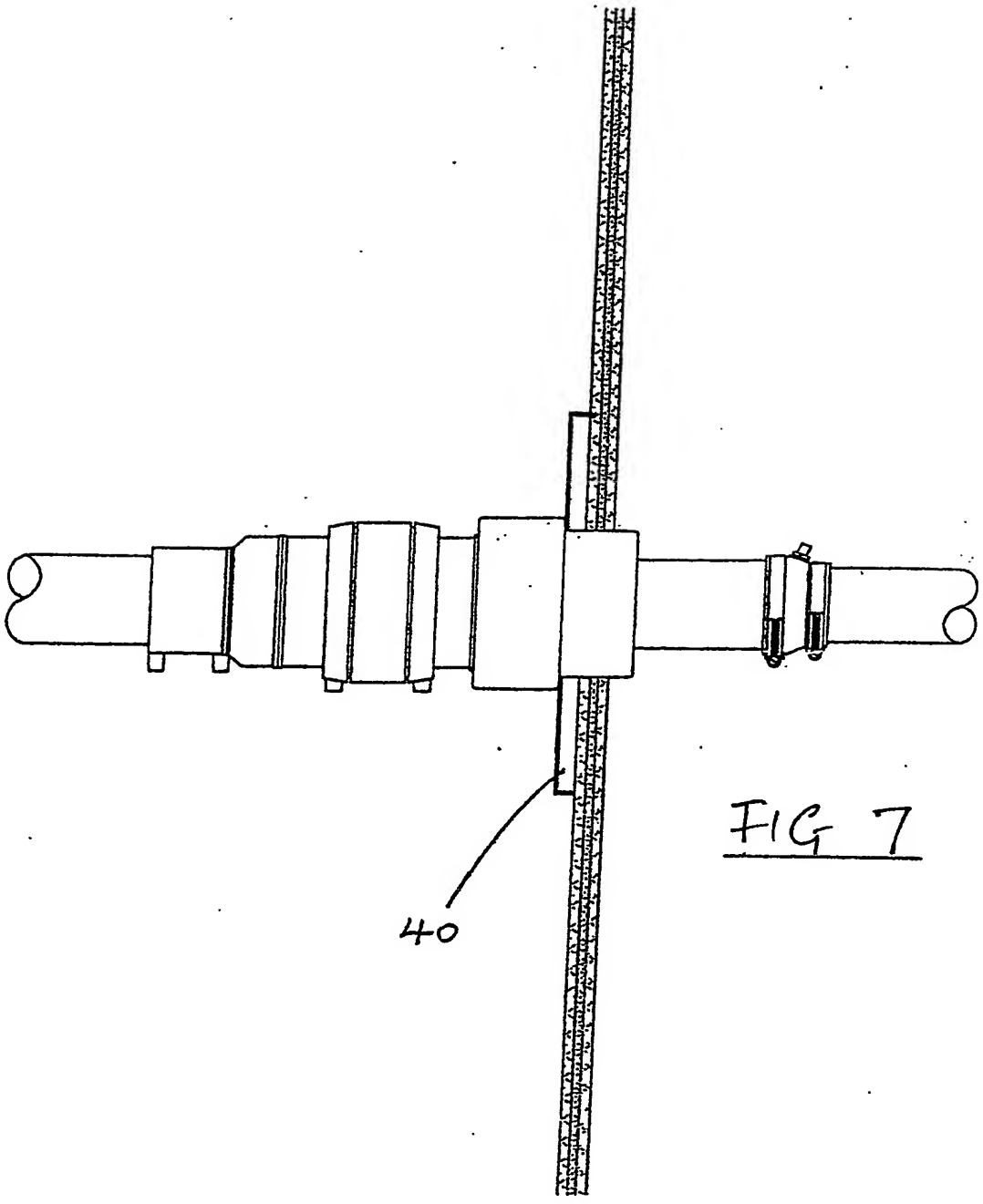

FIG 7

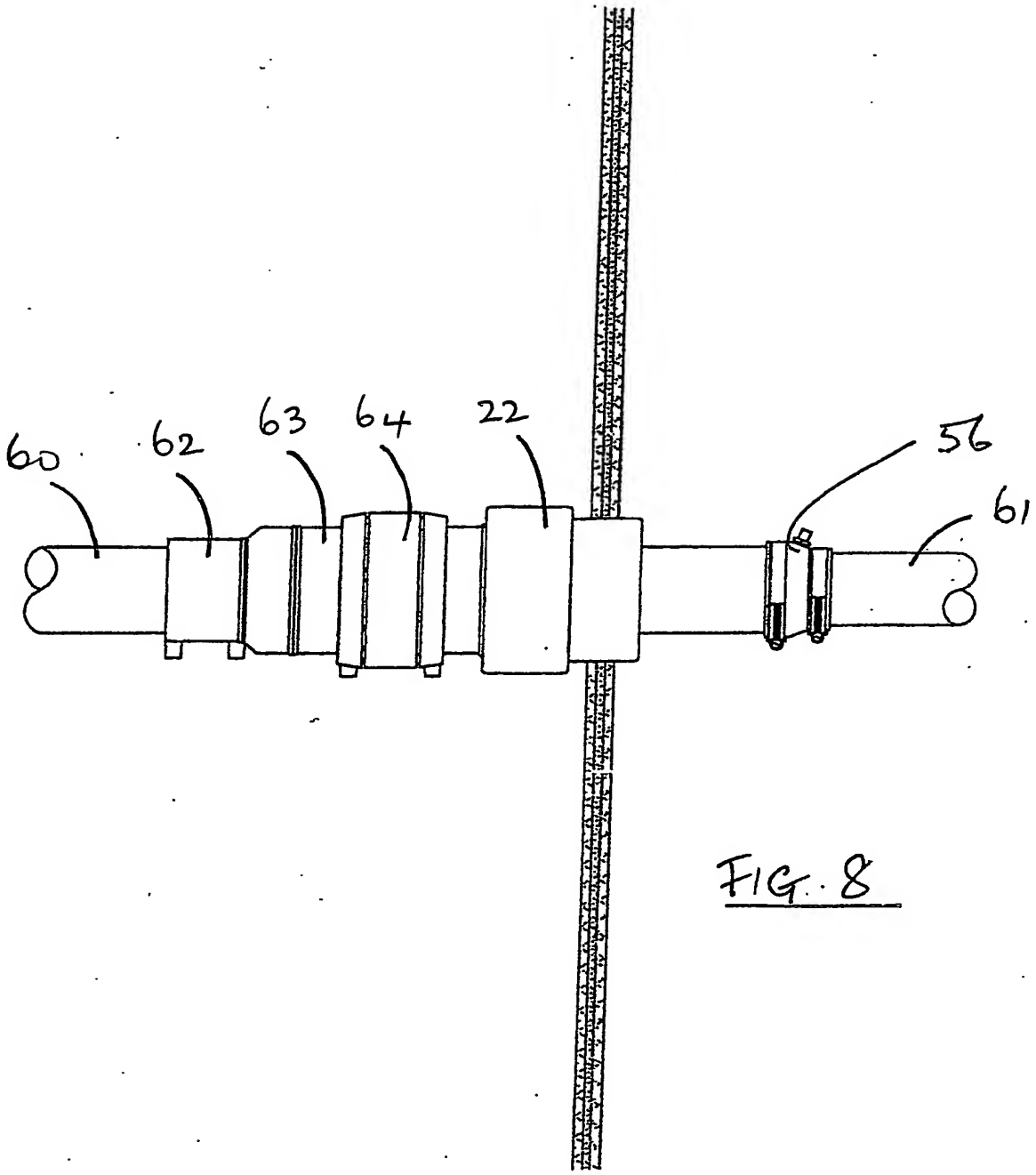

FIG. 8

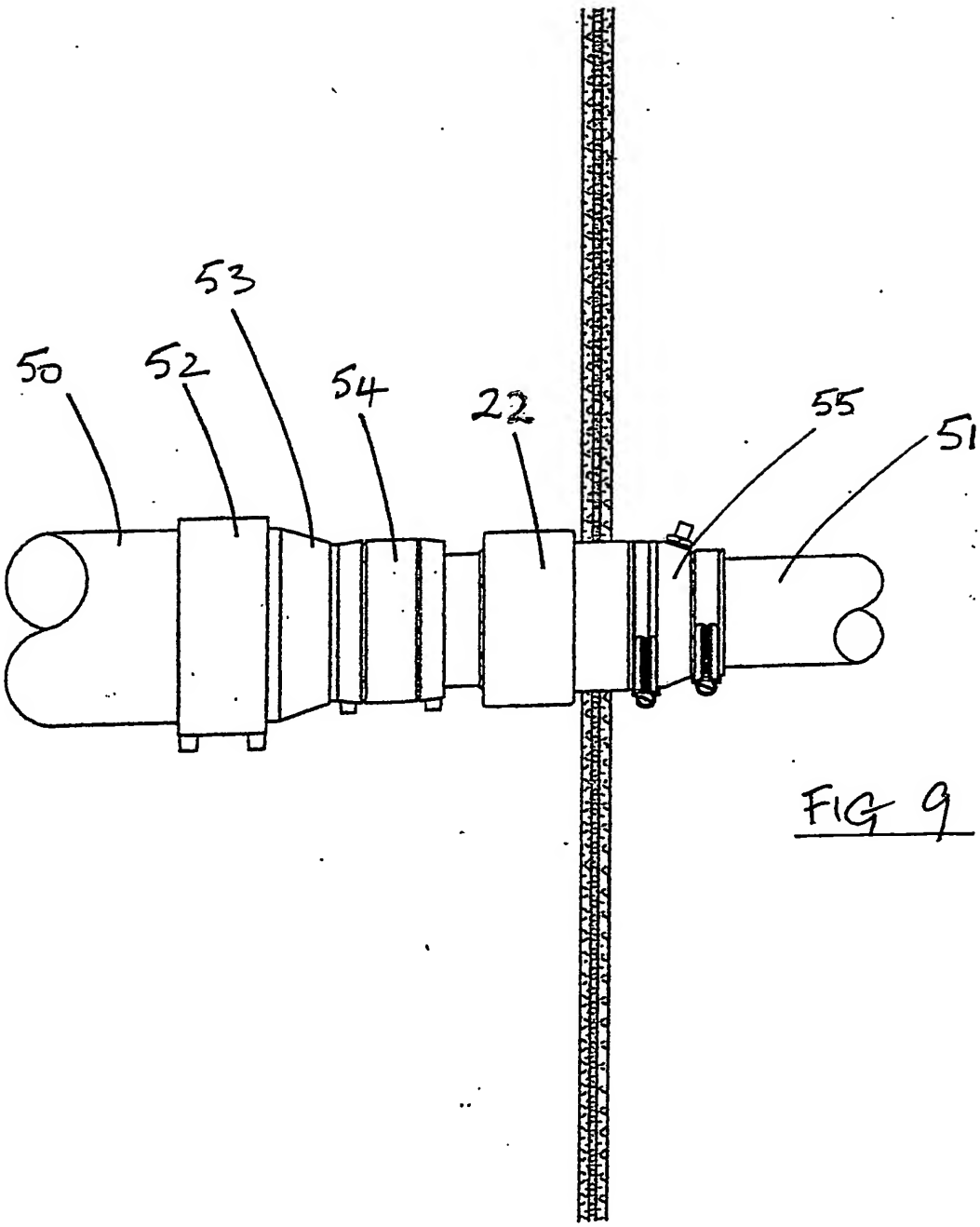

FIG 9

Document made available under the Patent Cooperation Treaty (PCT)

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International filing date: 25 November 2004 (25.11.2004)

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